of algebraic numbers, are instances of subjects the inception of which we owe to the Germany of the nineteenth century.

While, as we have already remarked, the English have shown a considerable interest in some branches of research, it is often said, and I think with truth, that our record in the history of modern mathematics is not worthy of our place among the nations. It is, at any rate, a fact that a considerable number of men spend the greater part of their student life in the special study of mathematics, and after a successful college career are appointed to teaching posts which leave them a fair amount of leisure for the pursuit of their chosen subject, and that, nevertheless, their life is barren of contributions to learning. This state of things, which we must admit to be much more general in this country than on the Continent, is, perhaps, the gravest feature in the situation at present, and it becomes deeply interesting to attempt to trace its course.

The explanation which I personally favour places the origin of the evil back in student days, and in our methods of instruction. The most casual reader of text-books cannot fail to be struck by the fact that English text-books treat their subjects in much greater detail than is customary on the Continent; innumerable side-issues are raised, trifles are elaborated, and examples are multiplied a hundredfold. Moreover, topics which have now become comparatively unimportant, or even positively obsolete, are always retained, and each text-book differs from its predecessor only in a further increase of prolixity.

The result is that even the best men cannot, in a student course of many years, wade through this mass of material to the frontier of existing knowledge, and the unfortunate student finds his college career over and his teaching life begun before he has gone anything like far enough to begin independent research.

I can scarcely conceive a greater benefit to the study of mathematics in this country than a series of short text-books holding closely to the main lines, casting away the rubbish and the trifles, and carrying a student to the furthest boundary of learning in a three years' university course.

Although the evil relates chiefly to college text-books, it would not be difficult to mention branches of higher learning the progress of which has been arrested for a long period simply by the publication of unreadable accounts of them.

In order that our research may be the worthy centre of a life-work, it is needful to have not merely the equipment of a full knowledge of the past, but also a clear and well-defined idea as to which are to be considered the chief and which the minor objects of investigation. For the next worse thing to doing no research at all is to spend one's time on matters that are of very little consequence.

This point is all the more important because there is every indication that we are now at a critical point in the history of mathematics, and that the twentieth century will see progress in somewhat different directions from those which characterised the last half of the nineteenth.

Let me recall the fact that, from the time of Newton to the death of Cauchy in 1857, the main progress of mathematics was in the realm of analysis—the science which is based on Newton's infinitesimal calculus, and which was enriched by all the greatest masters, Euler, Lagrange, Laplace, D'Alembert, the Bernouillis, Taylor, Legendre, Fourier, Gauss, Abel, Jacobi, and Cauchy.

The latter half of the nineteenth century saw, however, a notable change. As in the hands of these giants even the inexhaustible mine of analysis seemed to be worked out, new subjects came into prominence, such as invariants, the theory of groups, the Mengenlehre, analysis situs, quaternions, and non-Euclidean geometry; the theory of functions developed itself on lines quite foreign to the older analysts, and the demand for rigorous proofs led many even of those who remained in the domain of analysis, as Du Bois Reymond and Pringsheim, to devote themselves rather to a careful investigation of the foundations than to an extension of the superstructure. Now, however, we seem to be on the threshold of a change. The branches of mathematics the introduction of which we owe to the last generations of German mathematicians are already beginning to show signs of exhaustion—by which I mean that further work in such a subject as the invariant-theorem along the present lines does not promise to yield any great increase of mathematical power; the process of underpinning the edifice has now been, to a great extent, accomplished, and the work of upbuilding can be recommenced, while the interest of the theory of functions has largely passed over into topics of a distinctly analytical character, such as the theory of automorphic functions, the theory of expansions convergent within a given region, and the theory of summable series.

All the indications seem to point to the conclusion that pure mathematics is in the process of its natural evolution returning to the old path, and that a new phase of advance in the analysis of differential equations and functions is about to come upon us.

But though the same, it will be changed; the work of the last fifty years has given rise to ideas and methods the application of which must necessarily extend the older subjects in altogether new directions, and perhaps lead to an era worthy to be compared with that of Euler and Lagrange.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Joule studentship, founded "to assist research, especially among younger men, in those branches of physical science more immediately connected with Joule's work," will shortly become vacant through the termination of the tenure of Dr. Ulrich Behn, who was nominated by the K. Akademie der Wissenschaften of Berlin in 1901. On this occasion the nomination of a student rests with the president and council of the Royal Society, who will make their selection in October next. The studentship is of the value of 100*l*. in all. Information may be obtained from the assistant secretary of the Royal Society.

WE regret to see the announcement of the death of Sir Joshua Fitch at the age of seventy-nine. The country has thus lost one of its foremost authorities on educational theory and practice. Sir Joshua Fitch was for thirty-one years connected with the Education Department, and the wide and varied experience which he acquired give exceptional weight to his views on educational subjects, expressed in many articles, books and addresses. Since his retirement from official life in 1894, he has taken an active part in the formation of sound public opinion upon educational questions. He recognised that the important point to bring before the people was "that education ought to be a national concern, that it should not be left entirely to local, or private, or irresponsible initiative." This principle must be accepted before any substantial provision will be made for educational progress. Sir Joshua took an active part in the reorganisation of the University of London as a teaching university, and throughout his career identified himself with movements which had for their object the coordination and development of the educational forces of the country.

OF the Education Vote of 11,249,806*l*. agreed to by Committee of the House of Commons last Thursday, only half a million belongs to secondary education. In the course of a speech made in introducing the vote, Sir William Anson expressed the fear that the traditional educational work was being destroyed, and was not being replaced with anything of a really substantial character. He was especially alarmed at the condition of the smaller grammar schools. "In these schools much attention is now being given to science, with results that are not altogether satisfactory. The classical languages are almost disregarded, and history and geography are neglected." Mr. Balfour spoke to much the same effect in the speech at the Allied Colonial Universities dinner which appears in another part of this issue. The suggestion is that science is not such a good educational instrument as the study of dead languages. It does not need much consideration to see that these conclusions are unsound. For centuries our grammar schools have been training grounds for teachers of Greek and Latin, and it would be strange if efficient methods had not been evolved. Every encouragement has been given to the humanities both in school and university, and the masters who have controlled the curriculum or guided the studies have been, with rare exceptions, men distinguished for

their attainments in classical fields. It is scarcely too much to say that few of these men have welcomed the introduction of science into the school curriculum. But, for the sake of recognition by county councils, and the consequent grants, science has been given a place in grammar schools as a paying guest. In many cases the headmasters know nothing of science, and care less; and the teachers in charge of the science work receive little encouragement to do anything but push on promising pupils to scholarship examinations. It is, of course, impossible to discover the educational value of scientific studies under these conditions, when no provision has been made for the supply of qualified teachers, and while the idea still prevails among many masters that text-books and lectures are the most important means of imparting scientific knowledge. It would be strange if the results of such teaching were satisfactory. If Mr. Balfour and Sir William Anson will examine the matter a little more closely, they will see that no fair comparison can yet be made between the merits of classical and scientific studies. Everything depends upon the method by which the subject is taught, and the spirit which inspires the teacher.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 14.—"The 'Elasmometer,' a New Form of Interference Apparatus for the Determination of the Elasticity of Solid Substances." By A. E. H. **Tutton**, D.Sc., F.R.S.

The apparatus is designed to measure the amount of bending suffered by a thin plate of the substance investigated, when supported near its ends against a pair of platinum-iridium knife-edges, under a known weight applied at its centre. It consists of an elaborate apparatus for the support and adjustment of the plate and knife-edges; a measuring microscope, reading in two rectangular directions by a new method to the thousandth of a millimetre, for measuring the dimensions of the plate *in situ*; a specially constructed form of balance, one end of the beam of which carries an agate point, through which a pressure is applied under the centre of the plate equal to the weight in a pan suspended from the other end; a delicate control apparatus, which only permits the weight to operate extremely slowly; an interference apparatus, of which the two reflecting surfaces concerned in the interference are (1) the lower surface of a colourless glass disc supported on a tripod in rigid connection with the knife-edges, and (2) the upper surface of a smaller black glass disc forming the top of a counterpoised rocker, arranged to move with the centre of the plate and thus to transmit its motion. The amount of diminution in the thickness of the air film between the two glass surfaces, consequent on the bending of the plate, is given by the number of interference bands which pass the centre of reference, as seen in the micrometer eye-piece of the observing apparatus, multiplied by half the wave-length of the G or F hydrogen light which is employed. The optical apparatus of the dilatometer previously exhibited is utilised for the transmission of the hydrogen light to the interference apparatus, and as observing apparatus.

June 18.—"On the Discharge of Electricity from Hot Platinum." By Harold A. **Wilson**, D.Sc., B.A., Fellow of Trinity College, Cambridge. Communicated by C. T. R. Wilson, F.R.S.

This paper contains an account of a series of experiments on the discharge of electricity from hot platinum wires. The main object of the investigation was to determine the influence exerted by the nature of the gas in which the wire is immersed.

It was found that the presence of traces of hydrogen in the wire enormously increases the leak of negative electricity from it. By taking precautions to remove hydrogen the negative leak was diminished to one part in 250,000 of its usual value. The presence of traces of phosphorus pentoxide was found enormously to increase the negative leak, and it is known that alkali salts have a similar effect. The results obtained lead to the conclusion that the negative leak is due to the presence of traces of hydrogen, or possibly other substances, in the wire.

With a particular wire in air, the small negative leak remaining when impurities have been got rid of, as far as possible, only falls off very slowly with time, and its variation with the pressure of the air, the potential difference, and the temperature can be measured.

It is shown that the variation of the negative leak with the air pressure and potential difference is due to the ionisation of the air by collisions of the negative ions leaving the wire with the air molecules. If the P.D. used is too small to produce ionisation by collisions, the leak is independent of the air pressure.

The variation of the negative leak with the temperature is investigated, and a formula which represents it is deduced from thermodynamical considerations.

The negative leak in hydrogen at various pressures is measured and found to increase proportionally to the pressure at low pressures. It is shown that the negative leak depends on the amount of hydrogen occluded by the wire. The following table gives the negative leaks at 1400° C. at several pressures in hydrogen:—

Pressure.	Current per sq. centim.
133·0 mm.	$1·0 \times 10^{-3}$ ampere.
0·112 ,,	$1·2 \times 10^{-5}$,,
0·0013 ,,	$2·0 \times 10^{-7}$,,
0·0 ,,	$1·2 \times 10^{-10}$,,

The energy required for the production of a gram molecular weight of negative ions is found to have the following values:—

(1) Thoroughly clean wire in air or vacuum	155,000 calories.
(2) Cleaned wire in air or vacuum.	131,100 ,,
(3) Wire in H_2 at 0·0013 mm. ...	120,000 ,,
(4) ,, ,, 0·112 ,, ...	85,900 ,,
(5) ,, ,, 133·0 ,, ...	36,000 ,,

The paper also contains measurements of the positive leak. It is shown that there is no positive leak appreciable on a galvanometer from a clean wire in a vacuum. In air or hydrogen there is a positive leak, which increases with the gas pressure, and which is probably due to ionisation of the gas molecules in contact with the hot platinum.

It is probable that a pure platinum wire heated in a perfect vacuum would not discharge any electricity at all, either positive or negative, to an extent appreciable on a galvanometer.

"Upon the Bactericidal Action of some Ultra-violet Radiations as Produced by the Continuous-current Arc." By J. E. **Barnard** and H. de R. **Morgan**. Communicated by Sir Henry Roscoe, F.R.S.

The experiments described were carried out with the object of determining the effect on the vitality of bacteria, as the result of exposure to the arc spectra of carbon and of various metals.

The organisms experimented with have been the *Bacillus coli communis*, *B. prodigiosus*, *B. subtilis*, *Micrococcus tetragenus*, *Staphylococcus aureus* and *Bacillus tuberculosis*.

The conclusion arrived at is that the bactericidal action of light is almost entirely due to the action of those radiations in the ultra-violet region of the spectrum which are included between the wave-lengths 3287 and 2265. It is, therefore, necessary that any source of light used as a bactericidal agent should be rich in these rays.

Royal Meteorological Society, June 17.—Captain D. Wilson-Barker, president, in the chair.—Dr. W. N. **Shaw**, F.R.S., read a paper on the meteorological aspects of the storm of February 26–27. Between sunset of February 26 and noon of February 27, the British Isles were visited by a storm of unusual severity. Its most impressive characteristic was the amount of damage done to trees and buildings by gales from the south or south-west, particularly in the neighbourhood of Dublin, where very large numbers of trees were uprooted, and in Lancashire. Gales or strong winds were also experienced in many parts of the British Isles. Dr. Shaw exhibited lantern slides showing the path of the barometric minimum and the area over which the destruction extended. He also put forward some general considerations about barometric depressions and storms, dealing more especially with the distribution of winds and